Course Specification

(Postgraduate Programs)

Course Title:	**Advanced Electrochemistry and Corrosion**
Course Code:	**CHM 6145**
Program:	Master of science in chemistry
Department:	Chemistry
College:	Science
Institution:	Imam Mohammad Ibn Saud Islamic University
Version:	*Course Specification Version Number*
Last Revision Date:	*Pick Revision Date.*

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A. General information about the course:

1. Course Identification:

1. Credit hours: 3 (3 Lectures, 0 Lab, 0 Tutorials)

2. Course type

A.	☐University	☐College	☐Department	☐Track
B.	☐Required		☒ Elective	

3. Level/year at which this course is offered: Level 2/Year 1

4. Course General Description:

This course presents the fundamentals of the electrode-solution interface, theory of the electrode potential and potentiometry, kinetics of mass and electron transfer, and the electroanalytical techniques: Chronoamperometry and Chronocoulometry, Chronopotentiometry, Linear Sweep Voltammetry, Rotating Disk Electrode. Although these topics are already presented in several books but this information is often distributed in different books or reviews/articles. The purpose of this course is to give unified theory of these topics

5. Pre-requirements for this course (if any):

Advanced Physical Chemistry – CHM 6141

6. Pre-requirements for this course (if any):

None

7. Course Main Objective(s):

- Recognize advanced electrochemical processes and corrosion.
- Be familiar with Ion Conducting and Electronically Conducting Polymers.
- Memorize Potentiostatic and Galvanostatic Electrochemical methods.
- Develop awareness with Corrosion testing, monitoring and inspection.
- Interpret bimetallic corrosion and Polarisation resistance.

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100 %
2	E-learning		
3	Hybrid • Traditional classroom		

No	Mode of Instruction	Contact Hours	Percentage
	• E-learning		
4	Distance learning		

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	0
3.	**Field**	0
4.	**Tutorial**	0
5.	**Others (specify)……**	0
	Total	45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**To define the knowledge of fundamental Electrochemistry and describe the Kinetically and Mass Transport Controlled Electrochemical Processes.**	**K1. *Phy.*; K2. *Phy.*; K4. *Phy.***	▪ Five hours/week lectures. ▪ Self-study Home-exam.	▪ Regular Exams ▪ Assignments ▪ Short Quizzes ▪ Oral Discussion Participation.
1.2	**To list the Potentiostatic and Galvanostatic Electrochemical methods, the fundamentals of Corrosion, and the methods used to prevent the corrosion.**	**K2. *Phy.*; K4. *Phy.***	▪ Five hours/week lectures. ▪ Think to justify methods used to prevent the Corrosion, using available references (SDL) online	▪ Oral Discussion marks ▪ Literatures Survey ▪ Mini-seminar. ▪ Participation.

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
			Open discussion.	
1.3	**To recognize the Electrochemical processes and Corrosion applications in industry.**	**K2. *Phy.*; K4. *Phy.***	▪ Five hours/week lectures. Group Discussion on Electrochemical Processes applications using available references (SDL) online.	▪ *Midterm.* ▪ *Assignments.* ▪ Group Discussions. ▪ Literatures Survey ▪ Mini-seminar. Participation
1.4	**To state Homogeneous and Heterogeneous Electrocatalysis and its development as well as its importance.**	**K2. *Phy.*; K3. *Phy.*; K4. *Phy.***	▪ Five hours/week lectures. Group Discussion using available references (SDL) online.	▪ *Assignments* ▪ Open Discussions. ▪ Literatures Survey ▪ Mini-seminar. Participation.
2.0	**Skills**			
2.1	**To explain the concepts and principles of Electrochemistry and Corrosions.**	**S1. *Phy.*; S2. *Phy.*; S3. *Phy.***	▪ Lectures activity ▪ Self-study. Deep discussion on principles Electrochemistry and Corrosions.	▪ Questions in Lectures. ▪ Short Quizzes and Exams. ▪ Open Discussions. ▪ Participation Mini -seminar.
2.2	**To interpret Fundamentals of Corrosion and the methods used to prevent the Corrosion**	**S2. *Phy.*; S3. *Phy.***	▪ Practice some examples of Corrosion the methods used to prevent achieving. ▪ Brainstorming. Self-study	▪ Questions in Lectures. ▪ Participation ▪ Oral Discussion Short Quizzes.
2.3	**To summarize the concepts and principles of electrochemistry, Potentiostatic and Galvanostatic Electrochemical Methods data Analysis.**	**S1. *Phy.*; S2. *Phy.***	▪ Lectures ▪ Oral Discussions. ▪ Brainstorming. Self-study	▪ Questions in Lectures. ▪ Short Quizzes and Exams. ▪ Oral Discussion. Participation.

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.4	**To operate communication to electrochemistry and corrosions, its applications, and impact in KSA industrial sector accompanying writing of mini- Reports, operating electronic mail, and Network in communicating with others.**	**S1. *Phy.*; S2. *Phy.*; S3. *Phy.***	▪ Group Discussion and Assignments ▪ Suggest several applications of electrochemistry and corrosions, for reading, writing, and oral presentation in groups. Encourage students to use electronic mail to submit Home Exams and Assignments.	▪ Oral Discussion. ▪ Quizzes, and Exams. ▪ Giving marks for Oral Discussion in Lectures. Marks given for Assignments
3.0	**Values, autonomy, and responsibility**			
3.1	**To perform a scientific presentation, research, and work independently and integrate with a collaborated group, Using IT to acquire, analyze, and communicate information.**	**V1. *Phy.***	▪ Brainstorming. ▪ Exercises ▪ Group Discussion. Team work.	▪ Oral Discussion. ▪ Group Discussion ▪ Assignments.
3.2	**To demonstrate his ability to الeffectively the collaboration and inter-professionalism in class discussions or team works, as well as independently.**	**V1. *Phy.*; V2. *Phy.***	▪ Small Group tasks ▪ Open discussion at classroom. ▪ Office hour guiding. Group Presentation of mini-projects	▪ Participation ▪ Homework's Mini-project(s).

C. Course Content:

No	List of Topics	Contact Hours
1.	***Introduction to electrochemistry:*** Nernst Equation, Electrode Kinetics, Dynamic Eelectrochemistry, the Butler-Volmer and Tafel Equations. Overpotentials, Kinetically and Mass Transport Controlled Electrochemical Processes, Mass Transport by Migration, Convection and Diffusion, Conductivity, Solid State Electrochemistry, Ion Conducting and Electronically Conducting Polymers, The electrochemical Double Layer.	12
2.	***Potentiostatic and Galvanostatic Electrochemical Methods*:** Chronoamperometry, Coulometry, Cyclic Voltammetry, Chronopotentiometry, AC Impedance Spectroscopy, Spectroelectrochemistry and Hydrodynamic Methods. Surface Confined Electrochemical Processes.	8
3.	***The Fundamentals of Corrosionand the methods used to prevent the corrosion.*** theories of corrosion of metals, the most common depolarizers, types of corrosion, consequences of corrosion, factors that control the corrosion rate, Methods of corrosion rate measurement, and corrosion inhibited by different methods **(e.g. Cathodic protection).**	12
4.	***Homogeneous and Heterogeneous Electrocatalysis***: Electrochemical Processes Coupled to Chemical Steps. Nanostructured and Surface Modified Electrodes	7
5	***Introduction to Batteries*:** Fuel Cells and Electrochemical Solar Cells, Electrochemical Processes of Particular Relevance to Energy Conversion.	6
Total		45

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Class Activities (Open Discussion, Mini-reports, Oral Presentation, solving questions)**	**weekly**	**30 %**
2.	**Midterm Exam**	**9th week**	**30 %**
3.	**Final Exam**	**17 th week**	**40 %**
4.	**Total**		**100%**

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities:

1. References and Learning Resources:

Essential References	***Instrumental Methods in Electrochemistry***, Pletcher, D.; Greff, R.; Peat, R.; Peter, L. M., Woodhead Publishing, 2002. ISBN-13: 978-1898563808 ***Progress in Corrosion Science and Engineering***, Pyun, Su-Il; Lee, Jong-Won , Springer 2012. ISBN 978-0-387-92263-8 ***Electrochemistry Principles, Methods, and Applications***, Brett, Christopher M. A.; Brett, Ana Maria Oliveira, Oxford University Press; 1 edition, 1993. ISBN-13: 978-0198553885 ***Heterogeneous Electrode Processes and Localized Corrosion,*** Yongjun Tan, R. Winston Revie (eds.), 2013. ISBN: 9780470647950.
Supportive References	**None**
Electronic Materials	• Journal of Solid State Electrochemistry • Electrochemistry Communications Saudi Digital Library
Other Learning Materials	• Blackboard • Multimedia associated with the text book and the relevant websites.

3. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**Each of the classroom should be equipped with a whiteboard and a projector, with a maximum of 20 students.**
Technology equipment (projector, smart board, software)	**The rooms are equipped with data show, Smart Board, WI-FI access.**
Other equipment (depending on the nature of the specialty)	**None**

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	**Direct:** Questionnaire.
	Course Responsible	**Direct:** Course e-Portfolio.

Assessment Areas/Issues	Assessor	Assessment Methods
		Indirect: Second examiner checklist-Course report.
	Peer Reviewer	**Direct:** Questionnaire. **Indirect:** External assessor report.
Effectiveness of students assessment	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course report.
Quality of learning resources	Students	**Indirect:** Second examiner checklist-Course report.
	Faculty (Academic Advisory-GCC)	**Direct:** course Entrance/Exit. **Indirect:** Observations - Accreditation review.
	Program Leaders	**Direct:** Course e-Portfolio. **Indirect:** Course evaluation survey- Observations- Syllabus review- Accreditation review.
	Course Responsible	
The extent to which CLOs have been achieved	Course Responsible	**Direct:** Exams - Course e-Portfolio. **Indirect:** Second examiner checklist-Course report.
	Program Leaders	**Indirect:** Exams.
Other		

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	Council of Chemistry Department
REFERENCE NO.	10 (No. 2/10)
DATE	21/04/1444- 15/11/2022